

Derivatives Markets (Part 2)

An **equity-linked CD** guarantees to repay the invested amount, and it pays a certain percentage of the appreciation in the asset for which it is linked.

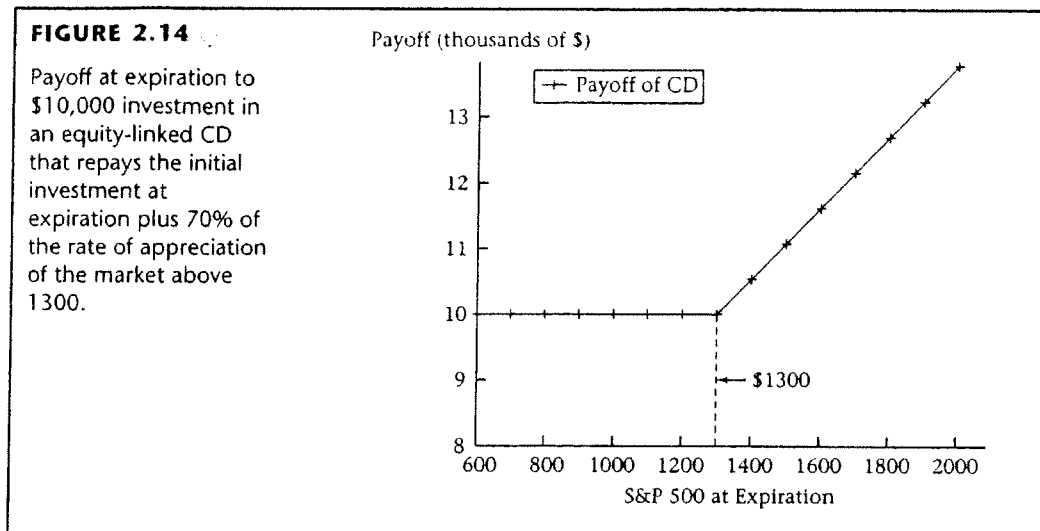


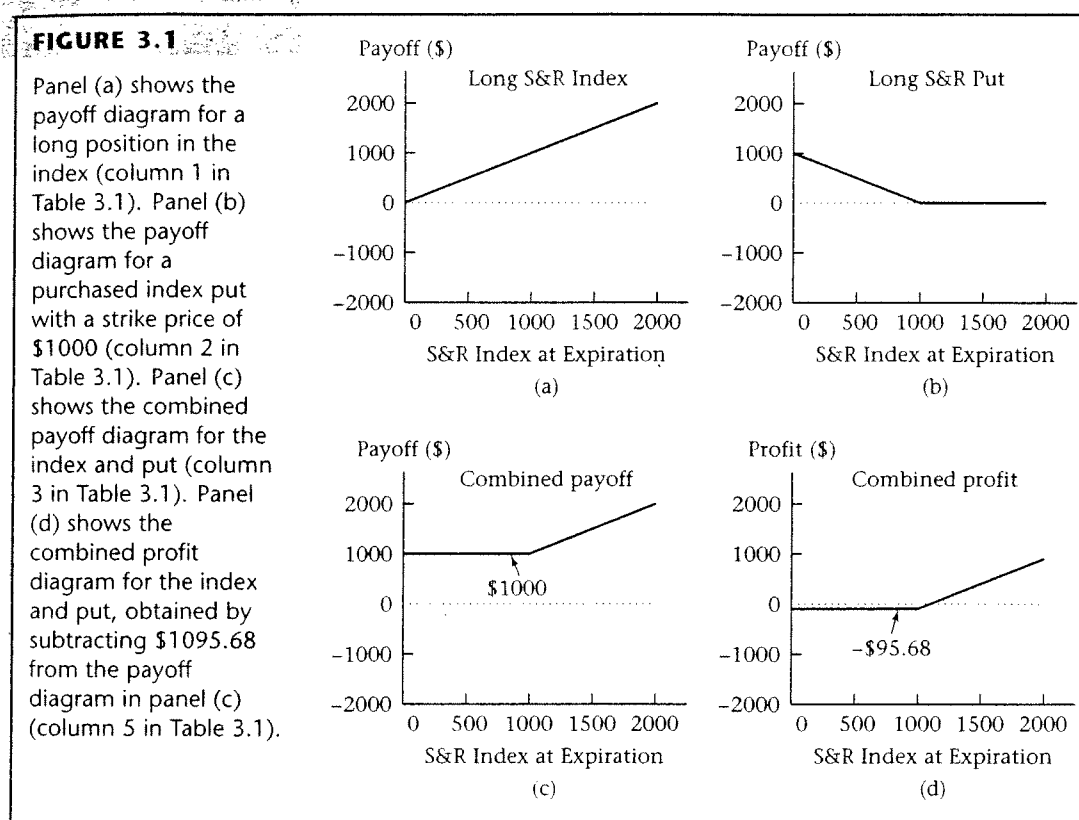
TABLE 2.5 Payoff of equity-linked CD at expiration.

S&P Index After 5.5 Years	CD Payoff
500	\$10,000.00
1000	10,000.00
1500	11,076.92
2000	13,769.23
2500	16,461.54
3000	19,153.85

Insurance, Collars, & Other Strategies

Basic Insurance Strategies: In the illustrations below, we assume the asset is the non-dividend paying hypothetical S&R Index with a current value of 1000, a risk-free rate of 2% seir, the premium for a 1000-strike 6-month call is \$93.809, and the premium for a 1000-strike 6-month put is \$74.201.

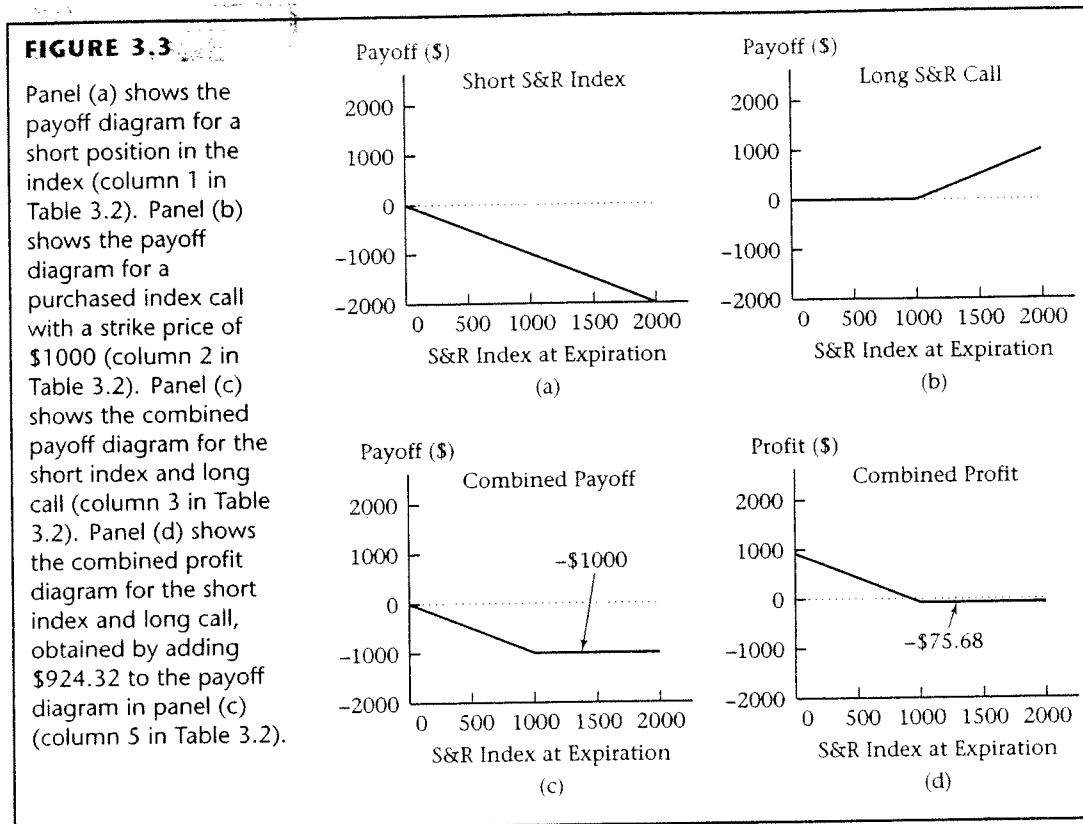
1. Long Underlying + Long Put (Called a **long floor** and guarantees a minimum sale price for the asset equal to the strike price of the put, $K = 1000$)



Notes:

- This looks like a long call. One difference is that a floor is more costly since you're paying for *both* the index and the put option, which together are more expensive than purchasing a call option
- The payoff diagram is equivalent to a long call + long bond position. (Long bond means long zero-coupon bond with redemption value, K)
- The profit diagram is equivalent to the profit diagram for a long call since the profit on a long (or short) bond position is zero.

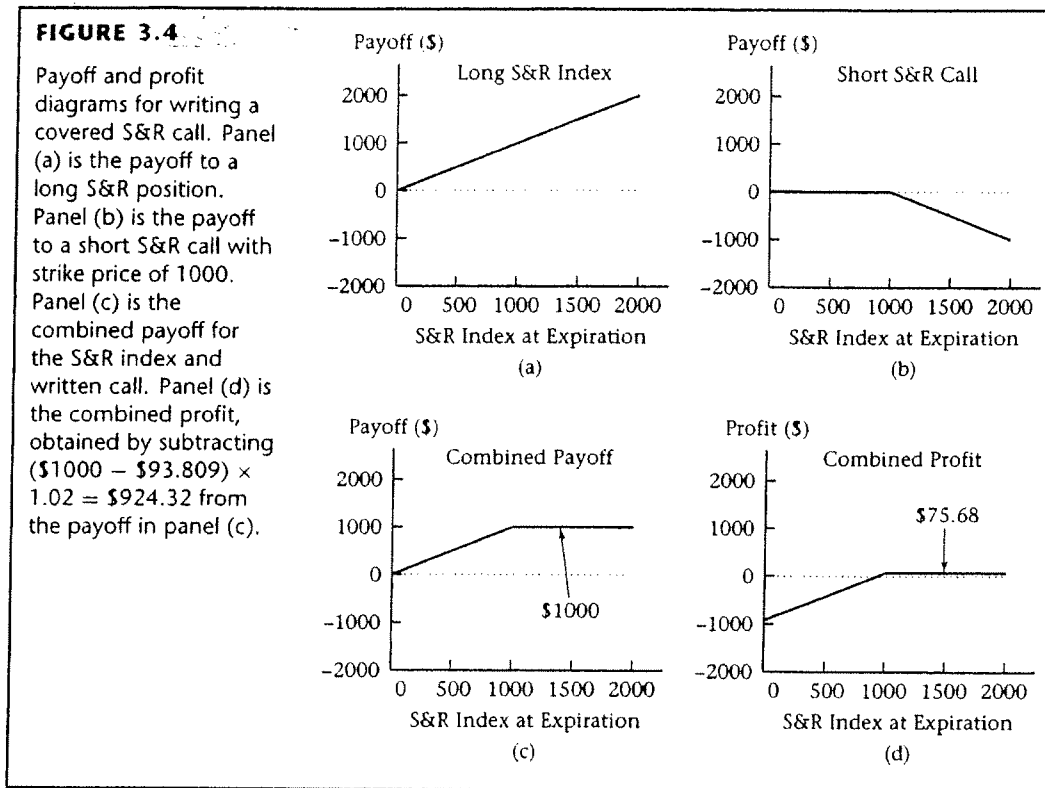
2. Short Underlying + Long Call (Called a **long cap** and protects against higher price of repurchasing the asset due to the short underlying position)



Notes:

- This looks like a long put.
- The payoff diagram is equivalent to a long put + short bond position.
- The profit diagram is equivalent to the profit diagram for a long put.

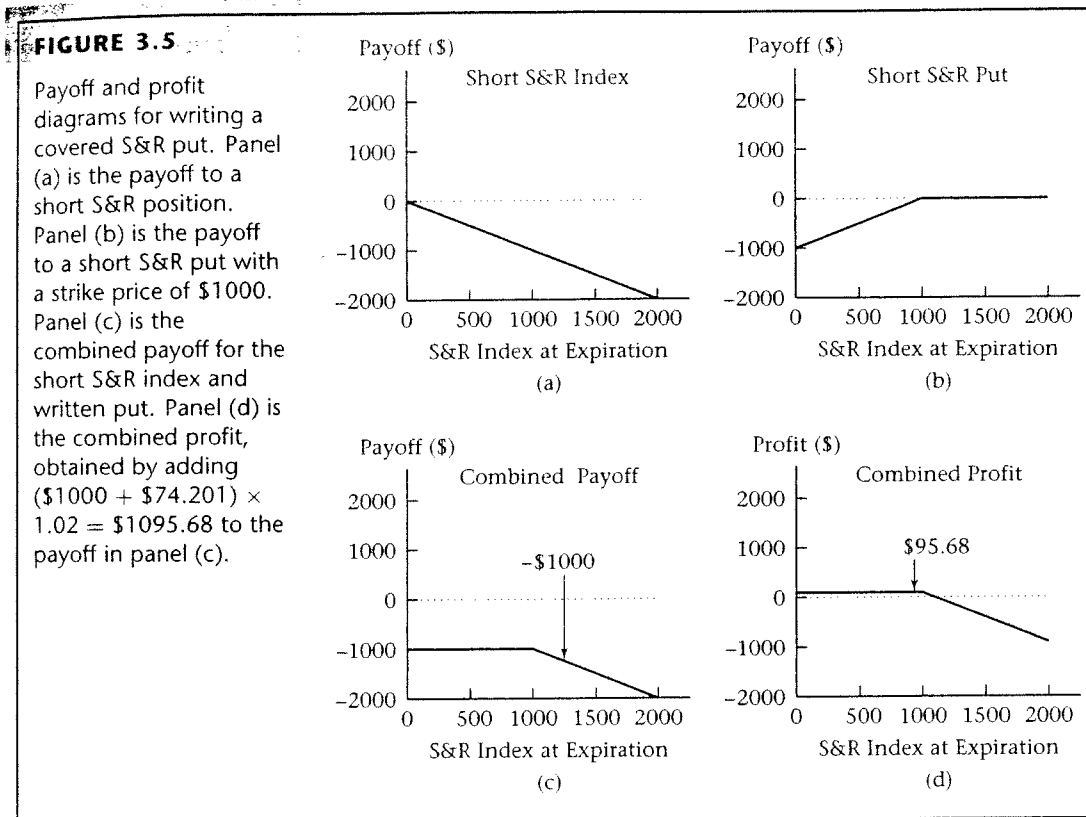
3. Long Underlying + Short Call (Use when you own the asset and have a neutral market view, i.e. you think the index is unlikely to move up or down)



Notes:

- This looks like a written put.
- Writing a call option when you are long underlying is called **covered call writing**, or **selling a covered call**.
- Naked writing** refers to a writer of an option that has no position in the underlying asset.

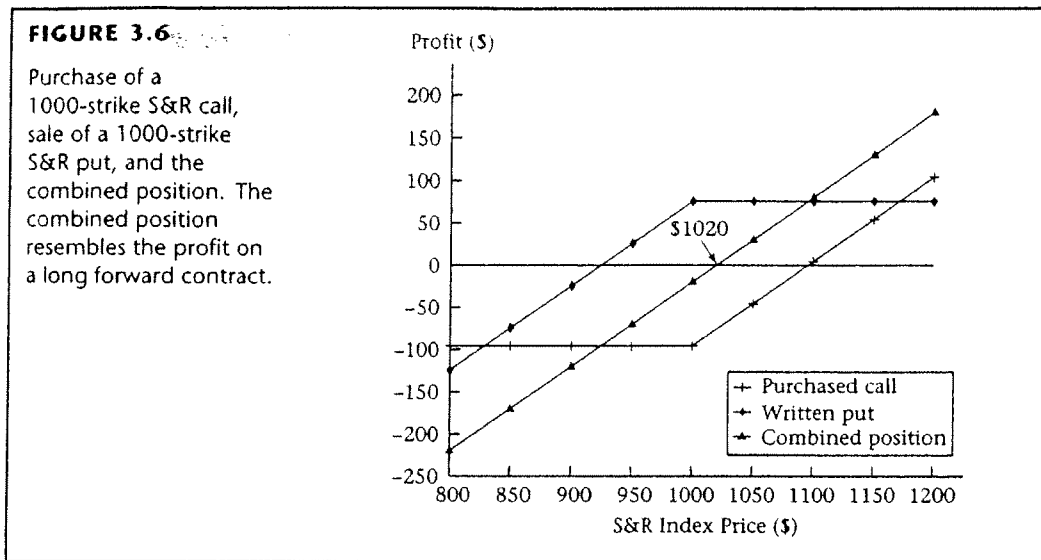
4. Short Underlying + Short Put



Note:

This looks like a written call, and is called a **covered put**.

Another Synthetic Long Forward: Long Call + Short Put



Differences between actual forward and synthetic forward

1. A forward contract has no premium.
 Synthetic forwards have net option premium of $Call(K,T) - Put(K,T)$.
2. In a long forward position, we pay the forward price, $F_{0,T}$
 In a long synthetic forward position, we pay the strike price K

In order to achieve a long forward position,
 we pay 0 today to buy the asset for $F_{0,T}$ at time T
 which gives a time 0 cost of $PV(F_{0,T})$.

In order to achieve a long synthetic forward position,
 we pay $Call(K,T) - Put(K,T)$ today to buy the asset for K at time T
 which gives a time 0 cost of $[Call(K,T) - Put(K,T)] + PV(K)$.

By indifference, the time 0 costs of a long forward position and a synthetic long forward position should be the same. The formula we get is called:

Put-Call Parity Formula: (under no arbitrage, $PV(F_{0,T}) = S_0$)

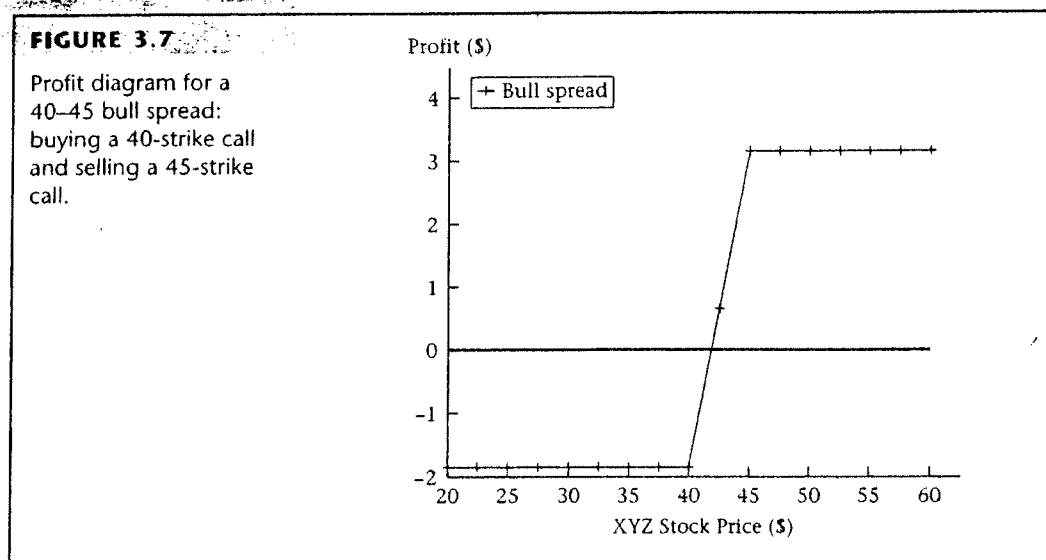
$$Call(K,T) - Put(K,T) = PV(F_{0,T}) - PV(K) = PV(F_{0,T} - K)$$

See basic strategies 1 – 4 above. For example, #1 above can be written
 $PV(F_{0,T}) + Put(K,T) = Call(K,T) + PV(K)$

Spreads

A K_1 - K_2 **bull spread** is a position achieved by buying a call at strike price K_1 and sell an otherwise identical call with a higher strike price, K_2 . (long call(K_1) + short call(K_2); $K_1 < K_2$) This position can also be achieved by buying a low-strike put and selling a high-strike put. (long put(K_1) + short put(K_2); $K_1 < K_2$)

Example 1: Given the premium for a 3-month 40-strike call option on a stock currently selling for \$40 is 2.78, and the premium for a 3-month 45-strike call option on the same stock is 0.97, graph the profit diagram of the bull spread achieved by purchasing the 40-strike call and selling the 45-strike call. The risk-free interest rate is 8.33% annual effective.



Example 2: Given the premium for a 3-month 40-strike put option on a stock currently selling for \$40 is 1.99, and the premium for a 3-month 45-strike put option on the same stock is 5.08, graph the profit diagram of the bull spread achieved by purchasing the 40-strike put and selling the 45-strike put. The risk-free interest rate is 8.33% annual effective.

Remark: You get the same graph in the examples above.

The opposite of a bull spread is a **bear spread**. For example, we can achieve a bear spread by taking a short call(40) + long call(45) position in the example above. The profit diagram is the negative of (reflect about the line $y=0$) the profit diagram for a bull spread.

Section 8 – Derivatives Markets (Part 2)

A **box spread** is achieved by using options to create a synthetic long forward at one price and a synthetic short forward at another price. (See “Another Long Synthetic Forward” above.) This strategy guarantees a cash flow in the future, and so it is an option spread that is purely a means of borrowing or lending money. It is costly, but has no asset price risk.

Example: Given the premium for a 3-month 40-strike call option on a stock currently selling for \$40 is 2.78, and the premium for a 3-month 45-strike call option on the same stock is 0.97, and the premium for a 3-month 40-strike put option on the same stock is 1.99, and the premium for a 3-month 45-strike put option on the same stock is 5.08, and using an annual effective risk-free interest rate of 8.33%, find the cost at time 0 and payoff at expiration of the box spread achieved by

1. Buying a 40-strike call and selling a 40-strike put, and
2. Selling a 45-strike call and buying a 45-strike put

Note:

This transaction can be described as a buying a 40-45 bull spread using calls and buying a 40-45 bear spread using puts.

A **ratio spread** is achieved by taking a long position in m calls at one strike price and a short position in n calls at a different strike price.

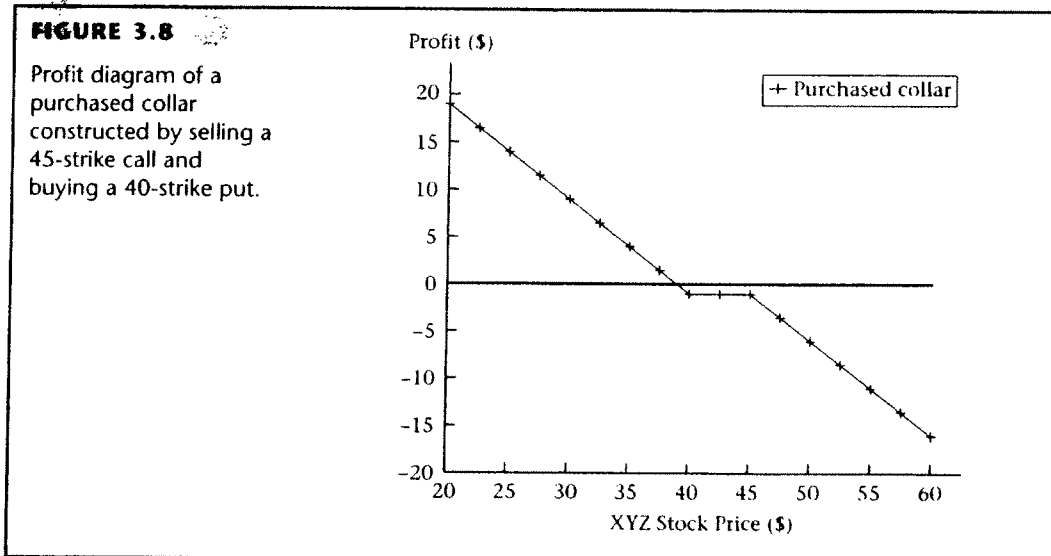
Note:

- a. Ratio spreads can also be constructed using puts
- b. It is possible to construct ratio spreads with no premium (no initial cost)

Section 8 – Derivatives Markets (Part 2)

A **K_1 - K_2 collar** is a long put(K_1) + short call(K_2) position, where $K_1 < K_2$. If the position is reversed, then the collar is written; i.e. a **written collar** is a short put(K_1) + long call(K_2) position. The **collar width** = $K_2 - K_1$.

Example: Determine the profit diagram for a 3-month 40-45 purchased collar if the premium for a 40-strike put is 1.99 and the premium for a 45-strike call is 0.97. The annual effective risk-free interest rate of 8.33%



Section 8 – Derivatives Markets (Part 2)

A K_1 - K_2 collar where K_1 and K_2 are chosen such that the two premiums exactly offset one another is called a **zero-cost collar**.

Example: A share of XYZ stock is purchased at \$40. A 3 month 40-41.72 zero-cost collar is also purchased. Determine the profit diagrams for the long stock position and the long stock + long collar position using an annual effective risk-free interest rate of 8.33%

